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Increased geomagnetic activity and the occurrence of bereavement hallucinations: evidence for melatonin-mediated microseizuring in the temporal lobe?

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This study was designed to test the hypothesis that common bereavement apparitions are hallucinatory experiences evoked by transient electrical instability within the (glucocorticoid) sensitized mesiobasal temporal lobes. All first hand reports of 'postmortem apparition' experiences were collected from a published data base. The days on which the experiences occurred displayed significantly greater (mean increase = 10 gamma) geomagnetic activity compared to the days before or afterwards. These results suggest that bereavement apparitions are situation-specific hallucinations evoked by microseizures within sensitized temporal lobe structures; the occurrence of these microseizures might be facilitated by suppression in melatonin levels that could accompany sudden increases in geomagnetic activity.

Deep temporal lobe structures, such as the amygdala and hippocampus, are the most electrically unstable structures of the human brain [3]. Hippocampal lability can be significantly sensitized by glucocorticoids [8, 19]. Rajaram and Mitra [18] recently reported that episodes of temporal lobe epilepsy were correlated with enhanced geomagnetic activity; a decrease in seizure threshold was associated with changes of only about 20 gamma [7]. In this context traditional correlations between psychiatric admissions and increased geomagnetic activity [2] become more relevant because of the intimate involvement of temporal lobe factors in schizophrenic and affective disorders [23].

That electrical stimulation of mesiobasal structures can evoke meaningful but hallucinatory experiences is well documented [3, 6, 9, 21]. One hypothesis [13, 15] is that a common form of bereavement phenomena often labelled 'postmortem apparitions' is due to microseizures within the mesiobasal temporal lobes (hippocampus and

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amygdala) that have been sensitized by elevated circulating glucocorticoids; they are a correlate of grief. Because of the endogenous bursting characteristics of hippocampal (and limbic) neurons [1], alterations in the endogenous anticonvulsant effects of circulating melatonin by subtle extremely low frequency magnetic fields [5] produced by geomagnetic activity might evoke microseizures that release intense situation-specific (grief-relevant) imagery.

There is ample correlative evidence that mystical bereavement experiences are temporal lobe phenomena. They are dominated by visual ('apparition') and then auditory ('messages') components [13, 14], the primary and secondary modalities that project into the human temporal lobe [24]. A large proportion of apparitions involves details that are memory fragments, particularly from the childhood of the experiencer [13, 14]. Most apparitions occur within the first 3 days of grieving (during peak circulating glucocorticoid periods), between 02.00 and 04.00 h local time and are frequently associated with 'suddenly awakening' or dreams; these periods are associated with pontine-geniculo-occipital (PGO) spikes and normal episodic (REM) activity that can be considered microseizures [21]. Recent evidence suggests that the *normal* brain contains electrically active microfoci within cortical columns [4] and that temporal lobe lability is strongly coupled with a propensity to report mystical (psi) experiences [16, 17].

To test this hypothesis *all* of the postmortem experiences that contained the day, month and year of occurrence were obtained from FATE magazine [17]; a total of 203 cases that were published over a 37 year period met this criterion. The cases were collected in 3 separate efforts (replications) from publication years: 1963–1969 ($n=75$), 1970–1985 ($n=65$) and 1949–1962 ($n=63$). The aa (average antipodal) index [12] was used as the measure of global geomagnetic activity. It was selected because daily indices were available for the years 1867 to present and many of the cases occurred before the beginning of more standard geomagnetic indices. The average aa indices for each of the 3 days before, the day of and for each of the 3 days after the days of the experience were obtained. If the hour was given, adjustments were made for the discrepancy between Greenwich time and local time by using appropriate half-day [12, 17] values. The mean aa values for the months and the years in which the experience occurred were also obtained for comparison only.

The results of the analysis can be seen in Fig. 1. Multiple analysis of variance (Manova; SPSSX software; VAX computer) demonstrated no significant difference between replications ($F_{2,200}=0.10$, $P\geqq 0.05$) but a highly significant difference between geomagnetic activity on different days ($F_{6,1200}=6.07$, $P\leqq 0.001$); the interaction was not significant ($F_{12,1200}=0.98$, $P\geqq 0.05$). A posteriori correlated t-test analysis demonstrated that the major source of the difference was due to increased geomagnetic activity on the days of the experiences compared to either or all of the days before or afterwards.

These results support the hypothesis that sudden increases in geomagnetic activity can facilitate the experience of bereavement hallucinations. The average increase was about 10 aa units, which is equivalent (in this range) to about 10-20 gamma; it might be recalled that an increase of 19 gamma was associated with a significant reduction

in seizure thresholds [7]. The primary remaining issue is the explanation of the specificity of the experience (the apparition of the recently deceased person). If Mahl et al. [9] are correct, then during electrical stimulation of temporal lobe structures, ideational content is transformed from thoughts into sensory images to which belief is attached; they then appear to be experienced. In bereavement situations the most likely ideational content is the subject of the hallucinations: the deceased person.

Geomagnetic perturbations within the range of 10–100 gamma can influence bird behavior [10]. Recently Subrahmanyam et al. [22] reported that comparable, experimentally produced 0.01 and 0.1 Hz fields with intensity variations between 5 and 50 gamma affected several physiological and behavioral measures in human volunteers. Although there are several mechanisms that might mediate such weak geomagnetic changes, the probable candidate involves pineal melatonin. This endogenous chemical displays anticonvulsant characteristics [11] and is responsive to static geomagnetic

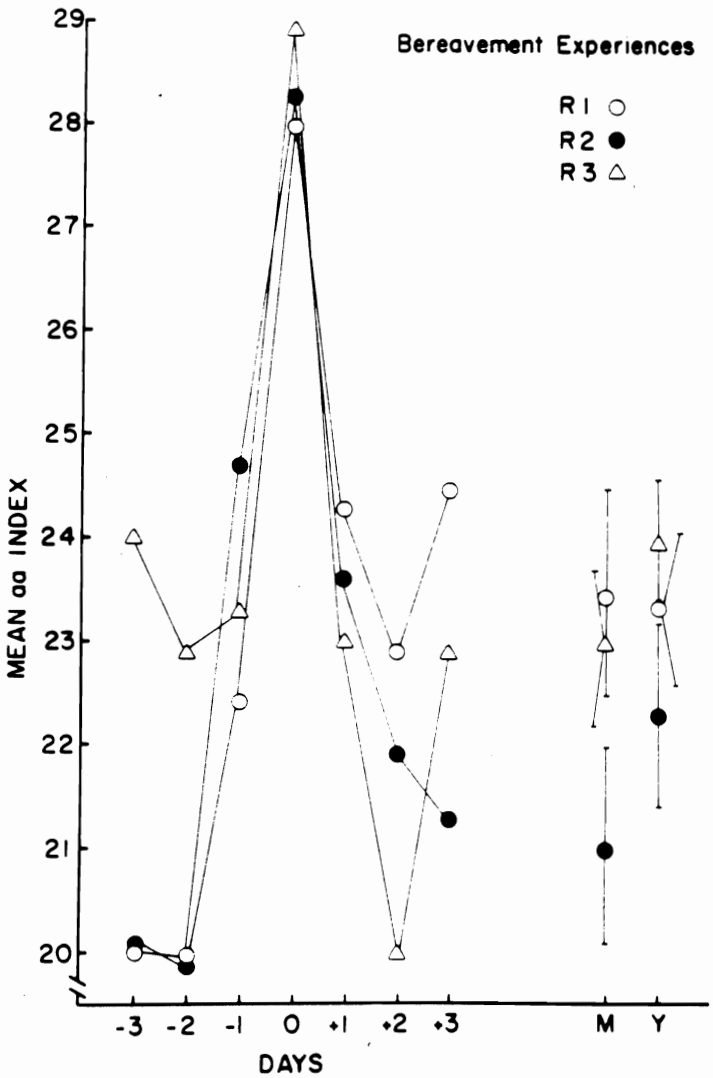

Fig. 1. Global geomagnetic activity (mean aa values) for the days of, before and after the experiences ($n = 203$) of bereavement hallucinations. M and Y refer to the aa averages for the months and years in which the experiences occurred. Vertical bars indicate standard error of the mean. R1 ($n = 75$), R2 ($n = 65$) and R3 ($n = 63$) refer to the different collections of experiences from different publication periods.

field strengths [20]. That increases in geomagnetic activity are associated with behavioral changes (in mice) that are similar to light-induced suppression of pineal melatonin has been reported by Ossenkopp et al. [11]. Considering the nocturnal predilection for bereavement experiences [13] a similar mechanism might trigger burst firing within sensitized hippocampal neurons following PGO spikes from the locus ceruleus [21].

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